WE CLAIM:

1. An optical device comprising:

(a) a two-dimensional grating comprised of a material having a high refractive index; and

(b) a substrate layer that supports the two-dimensional grating;

wherein, when the optical device is illuminated a resonant grating effect is produced on the reflected radiation spectrum, and wherein the depth and period of the two-dimensional grating are less than the wavelength of the resonant grating effect.

2. The optical device of claim 1, wherein a narrow band of optical wavelengths is reflected from the optical device when the optical device is illuminated with a broad band of optical wavelengths.

3. The optical device of claim 1, wherein the substrate comprises glass, plastic or epoxy.

4. The optical device of claim 1, wherein the two-dimensional grating is comprised of a material selected from the group consisting of zinc sulfide, titanium dioxide, tantalum oxide, and silicon nitride.

5. An optical device comprising a substrate and a two-dimensional grating wherein the substrate and the two-dimensional grating comprise a single unit, wherein the surface of the single unit comprising the two-dimensional grating is coated with a material having a high refractive index.

6. The optical device of claim 5, wherein the single unit is comprised of a material selected from the group consisting of glass, plastic, and epoxy.

7. The optical device of claim 5, wherein the material having a high refractive index is selected from the group consisting of zinc sulfide, titanium dioxide, tantalum oxide, and silicon nitride.

8. The optical device of claim 1 further comprising a cover layer on the surface of the two-dimensional grating opposite of the substrate layer.

9. The optical device of claim 8, wherein the cover layer comprises a material that has a lower refractive index than zinc sulfide, titanium dioxide, tantalum oxide, and silicon nitride.

10. The optical device of claim 9, wherein the cover layer comprises a material selected from the group consisting of glass, epoxy, and plastic.

11. The optical device of claim 1, wherein the two-dimensional grating is comprised of a repeating pattern of shapes selected from the group consisting of lines, squares, circles, ellipses, triangles, trapezoids, sinusoidal waves, ovals, rectangles, and hexagons.

12. The optical device of claim 11, wherein the repeating pattern of shapes are arranged in a rectangular grid or hexagonal grid.

13. The optical device of claim 1, wherein the two-dimensional grating has a period of about 0.01 microns to about 1 micron and a depth of about 0.01 microns to about 1 micron.

14. A system comprising the optical device of claim 1, a light source that directs light to the optical device, and a detector that detects light reflected from the optical device.

15. The detection system of claim 14, further comprising a fiber probe comprising one or more illuminating optical fibers that are connected at a first end to the light source, and one or more collecting optical fibers connected at a first end to the detector, wherein the second ends of the illuminating and collecting fibers are arranged in line with a collimating lens that focuses light onto the optical device.

16. The detection system of claim 15, wherein the illuminating fiber and the collecting fiber are the same fiber.

17. The detection system of claim 14, wherein the light source illuminates the optical device from its top surface or from its bottom surface.

18. A biosensor comprising:

(a) a two-dimensional grating comprised of a material having a high refractive index, wherein the two-dimensional grating is comprised of a repeating pattern of shapes selected from the group consisting of lines, squares, circles, ellipses, triangles, trapezoids, sinusoidal waves, ovals, rectangles, and hexagons;

(b) a substrate layer that supports the two-dimensional grating; and

(c) one or more specific binding substances immobilized on the surface of the two-dimensional grating opposite of the substrate layer;

wherein, when the biosensor is illuminated a resonant grating effect is produced on the reflected radiation spectrum, and wherein the depth and period of the two-dimensional grating are less than the wavelength of the resonant grating effect.

19. The biosensor of claim 18, wherein the repeating pattern of shapes of the two-dimensional grating are arranged in a rectangular grid or hexagonal grid.

20. The biosensor of claim 18, further comprising an antireflective physical structure that is embossed into a surface of the substrate opposite of the two-dimensional grating.

21. The biosensor of claim 20, wherein the antireflective physical structure is a motheye structure.

22. A detection system comprising the biosensor of claim 18, a light source that directs light to the biosensor, and a detector that detects light reflected from the biosensor.

23. The detection system of claim 22, further comprising a fiber probe comprising one or more illuminating optical fibers that are connected at a first end to the light source, and one or more collecting optical fibers connected at a first end to the detector, wherein the second ends of the illuminating and collecting fibers are arranged in line with a collimating lens that focuses light onto the biosensor.

24. The detection system of claim 23, wherein the illuminating fiber and the collecting fiber are the same fiber.

25. The detection system of claim 21, wherein the light source illuminates the biosensor from its top surface or from its bottom surface.

26. An optical device comprising:

(a) a sheet material having a first and second surface, wherein the first surface defines relief volume diffraction structures; and

(b) a reflective material coated onto the first surface of the sheet material;

wherein the optical device is capable of reflecting light predominantly at a first single optical wavelength when illuminated with a broad band of optical wavelengths as a result of optical interference.

27. The optical device of claim 26, further comprising a light source that directs light to the reflective surface and a detector that detects light reflected from the reflective surface.

28. The optical device of claim 26, wherein the relief volume diffraction structures are about 0.5 microns to about 5 microns in diameter.

29. A detection system comprising:

(a) a biosensor comprising:

(i) a sheet material having a first and second surface, wherein the first surface defines relief volume diffraction structures;

(ii) a reflective material coated onto the first surface of the sheet material; and

(iii) one or more specific binding substances immobilized on the reflective material; wherein the biosensor reflects light predominantly at a first single optical wavelength when illuminated with a broad band of optical wavelengths, and wherein the biosensor reflects light at a second single optical wavelength when the one or more specific binding substances are immobilized

on the reflective surface, wherein the reflection at the second optical wavelength of light results from optical interference; and

(c) a light source that directs light to the reflective surface of the biosensor; and

(d) a detector that detects light reflected from the reflective surface of the biosensor.

30. A resonant reflection structure comprising a two-dimensional grating having a pattern of concentric rings, wherein the difference between an inside diameter and an outside diameter of each concentric ring is equal to about one-half of a grating period, wherein each successive ring has an inside diameter that is about one grating period greater than an inside diameter of a previous ring wherein when the structure is illuminated with an illuminating light beam, a reflected radiation spectrum is produced that is independent of an illumination polarization angle of the illuminating light beam.

31. The structure of claim 30, wherein when the structure is illuminated a resonant grating effect is produced on the reflected radiation spectrum, wherein the depth and period of the two-dimensional grating are less than the wavelength of the resonant grating effect, and wherein a narrow band of optical wavelengths is reflected from the structure when the structure is illuminated with a broadband of optical wavelengths.

32. The structure of claim 30, wherein the two-dimensional grating has a period of about 0.01 microns to about 1 micron and a depth of about 0.01 microns to about 1 micron.

33. A transmission filter structure comprising a two-dimensional grating arranged in a pattern of concentric rings, wherein the difference between an inside diameter and an outside diameter is equal to about one-half of a grating period, wherein each successive concentric ring has an inside diameter that is about one grating period greater than an inside diameter of a previous ring, wherein when the structure is illuminated with an illuminating light beam, a transmitted radiation spectrum is produced that is independent of an illumination polarization angle of the illuminating light beam.

34. The structure of claim 33, wherein when the structure is illuminated a resonant grating effect is produced on the reflected radiation spectrum, wherein the depth and period of the two-dimensional grating are less than the wavelength of the resonant grating effect, and wherein a narrow band of optical wavelengths is reflected from the structure when the structure is illuminated with a broad band of optical wavelengths.

35. The structure of claim 33, wherein the two-dimensional grating has a period of about 0.01 microns to about 1 micron and a depth of about 0.01 microns to about 1 micron.

36. A resonant reflection structure comprising an array of holes or posts arranged such that the holes or posts are centered on corners and in the

center of hexagons, wherein the hexagons are arranged in a closely packed array, wherein when the structure is illuminated with an illuminating light beam, a reflected radiation spectrum is produced that is independent of an illumination polarization angle of the illuminating light beam.

37. The structure of claim 36, wherein when the structure is illuminated a resonant grating effect is produced on the reflected radiation spectrum, wherein the depth or height and period of the holes or posts are less than the wavelength of the resonant grating effect, and wherein a narrow band of optical wavelengths is reflected from the structure when the structure is illuminated with a broad band of optical wavelengths.

38. The structure of claim 36, wherein the array holes or posts have a period of about 0.01 microns to about 1 micron and a depth of height of about 0.01 microns to about 1 micron.

39. A transmission filter structure comprising an array of holes or posts arranged such that the holes or posts are centered on corners and in the center of hexagons, wherein the hexagons are arranged in a closely packed array, wherein when the structure is illuminated with an illuminating light beam, a transmitted radiation spectrum is produced that is independent of an illumination polarization angle of the illuminating light beam.

40. The structure of claim 39, wherein when the structure is illuminated a resonant grating effect is produced on the reflected radiation spectrum, wherein the depth or height and period of the array of holes or posts are less than the wavelength of the resonant grating effect, and wherein a

narrow band of optical wavelengths is reflected from the structure when the structure is illuminated with a broad band of optical wavelengths.

41. The structure of claim 39, wherein the array of holes or posts have a period of about 0.01 microns to about 1 micron and a depth or height of about 0.01 microns to about 1 micron.

42. An optical device comprising:

(a) a first two-dimensional grating comprising a high refractive index material and having a top surface and a bottom surface; and

(b) a second two-dimensional grating comprising a high refractive index material and having a top surface and a bottom surface, wherein the top surface of the second two-dimensional grating is attached to the bottom surface of the first two-dimensional grating;

wherein, when the biosensor is illuminated two resonant grating effects are produced on the reflected radiation spectrum, and wherein the depth and period of both of the two-dimensional gratings are less than the wavelength of the resonant grating effects.

43. The optical device of claim 42, wherein a substrate layer supports the bottom surface of the second two-dimensional grating.

44. An optical device comprising:

(a) a first two-dimensional grating comprising a high refractive index material and having a top surface and a bottom surface;

(b) a substrate layer comprising a top surface and a bottom surface, wherein the top surface of the substrate supports the bottom surface of the first two-dimensional grating; and

(c) a second two-dimensional grating comprising a high refractive index material and having a top surface and a bottom surface, wherein the bottom surface of the second two-dimensional grating is attached to the bottom surface of the substrate;

wherein, when the biosensor is illuminated two resonant grating effects are produced on the reflected radiation spectrum, and wherein the depth and period of both of the two-dimensional gratings are less than the wavelength of the resonant grating effects.